REMARKS

Paragraphs **[0011]** and **[0028]** in the Specification have been amended, claims 1, 3, 6, 7, 8, 9, 12, 13, 14 and 15 have been canceled, and claims 2, 4, 10, 16, 17, 19, 20 and 21 have been amended. In view of these amendments and the following remarks, a reconsideration and allowance of the application is requested.

It is believed the amendments to paragraphs **[0011]** and **[0028]** correct the informalities in the drawings and specification noted by the Examiner.

It is believed that amendments have been made to the claims which address each of the claim objections and each of the §112 rejections made by the Examiner. Applicant's attorney thanks the Examiner for the very careful review of the claim language and welcomes any further suggestions for improvement in claim language.

Applicant agrees with the Examiner's rejections of the broad claims of this application under 35 U.S.C. §103. This is confirmed by the recently discovered US Patent No. 5,841,831 which was cited in Applicant's July 6, 2005 Information Disclosure Statement. This patent was brought to Applicant's attention recently by a colleague from another research institution. While the prior art discloses a CT system with an x-ray source that can scan a cone beam both around the patient and electronically along the z-axis, the present application discloses a number of improvements to this basic concept which are unique and nonobvious. Applicant therefore traverses the Section 103 rejection of pending claims 2, 4, 5, 10, 11 and 16-21 which are directed to these improvements and which will now be discussed.

Claim 2 This claim is distinguished over the prior art by the step of repeating the acquisition of x-rays along a second scan path that is "interleaved" with the first prescribed scan pattern. The ability to both revolve the x-ray source around the subject and electronically move it along the z-axis provides the opportunity for unique scan patterns that can be interleaved with each other. Such an interleaved pattern is shown in Fig. 5C and described at paragraph **[0044]**. None of the prior art references disclose or suggest such a capability. The Examiner cites Morgan as disclosing this step, but it does not. Morgan discloses a CT system which generates a

plurality of adjacent fan beams simultaneously. This is roughly the equivalent of producing a single cone beam from which a plurality of slice images can be reconstructed. There is no suggestion in the Morgan reference that the scan pattern can be repeated in such a manner as to produce interleaved scan patterns. The description at the top of Column 6 merely suggests that one can use less than all the multiple fan beams during any particular scan. Thus, Morgan performs a multi-slice scan using a plurality of x-ray sources much like a single cone beam scan can acquire multiple slices. There is no teaching as to how or why an interleaved scan would be done with the Morgan system or the Lanzara or Ooshima systems. Claim 2, therefore, recites patentable subject matter and allowance of the same is requested.

Claim 4 and dependent Claim 5 These claims are distinguished over the prior art references by the step of initiating a scan pattern of the x-ray source around the subject and along the axial dimension (z-axis) in response to a "cardiac trigger signal". Claim 5 is more limited in that the axial scan is said to occur a plurality of times after each cardiac trigger signal. The cited prior art discloses conventional CT systems which can be cardiac gated to acquire sets of data from which images can be reconstructed (e.g., Rasche et al). The prior art teach that one or more views can be acquired after each cardiac trigger signal as the x-ray source rotates around the subject. Other prior art (e.g., Lanzara et al) teaches that the x-ray source can be moved around the subject and along the axial dimension, but no prior art reference teaches how to conduct a cardiac gated scan with such an improved CT system.

See paragraphs **[0049]** through **[0052]** of the present application for a description of a preferred embodiment of a cardiac gated scan according to the present invention. In this preferred embodiment the trigger signal not only gates the acquisition of data, but also alters the scan pattern. That is, the x-ray source revolves around the patient and when the trigger signal is received, the scan pattern changes to move the x-ray source along the axial dimension and to acquire data. There is no suggestion in the prior art that one should move the x-ray source around the subject and use the cardiac trigger signal to perform one or more scans along the axial dimension. Claims 4 and 5 are directed to the concept of using the cardiac signal to trigger a

scan along the axial dimension and this novel feature is believed to patentably distinguish over the prior art.

Claim 10 and Dependent Claim 11 Claim 10 recites a CT system that produces a cone beam that is rotated around the subject and electronically moved along the central axis. As amended, this CT system includes a collimator that is disposed between the subject (located in the "cylindrical region of interest") and the detector array and in which the collimator has channels directed along the axis. This feature is shown in Figs. 3 and 9 and described at paragraphs **[00036-00037]**.

The prior art does not disclose such a collimator. Lanzara et al is cited by the examiner, but the collimator 51 disclosed therein has channels disposed in the circumferential direction, not the axial direction. Such a collimator will work with a fan beam as described in Lanzara et al, but not a cone beam as required by the present invention. No collimator which will work with the claimed CT system is disclosed in the cited prior art. Claims 10 and 11 are, therefore, believed to recite patentable subject matter.

Claim 16 and Dependent Claims 17-18 Claim 16 recites a method for producing an image with a CT system that is capable of moving an x-ray source around the subject and along the central axis in a spiral pattern such as that shown in Fig. 5C and described in paragraphs **[0044-00045]**. Claim 16 further recites how this acquired data is processed to reconstruct an image with reduced undersampling artifacts without loosing temporal resolution. More specifically, the acquired projection attenuation data is transformed to k-space, combined in an advantageous manner, and the combined k-space data is then used to reconstruct an image.

The prior art does not disclose or suggest the method recited in claim 16. The Examiner cites the Hu et al CT system combined with the Mistretta et al MRI system. These references fall far short of the invention recited in claim 16. First, the Hu et al CT system does not interleave spiral scan patterns. Instead, Hu et al is a conventional cone beam CT system which can perform a spiral scan by rotating the gantry and moving the subject through the gantry as depicted in Fig. 3 and described at Col. 9, lines 11-18. A single spiral scan pattern as depicted in Fig. 5B of the present application is all that the Hu et al CT system can do. There is no

suggestion of repeating the spiral scan pattern to acquire interleaved data as required by claim 16 and depicted in Fig. 5C of the present application. Indeed, such a scan could not be accomplished using the Hu et al system which does not have the ability to electronically move the x-ray source along the axial dimension (step c in claim 16). Steps c) and d) are thus missing from the Hu et al reference along with steps e), f) and g).

The Examiner appreciates that Hu et al does not disclose steps e), f) and g). Instead, the Examiner argues it would be obvious to combine the teachings of the Mistretta et al MRI patent with Hu et al. This is wrong for a number of reasons. Mistretta discloses an MRI system in which a pulse sequence (Fig. 3) is performed to acquire sets of k-space data. The k-space data is acquired directly by sampling the received NMR signal (Col. 6, line 64 through Col. 7, line 9). There is nothing disclosed in Mistretta et al that corresponds to step e) of claim 16 because an MRI acquires k-space data directly and a conversion step makes no sense. Hu et al discloses a cone beam image reconstruction method depicted in Fig. 9 thereof which includes a backprojection step typically seen in x-ray CT systems. None of these backprojection methods involve transforming the acquired attenuation data to k-space and such a step is totally incompatible with the reconstruction method disclosed in Hu et al. Stated another way, no one skilled in the x-ray CT art would go out of their way to convert the acquired data to k-space data and then look at how the MRI art reconstructs images from such k-space data, when there are many well-known backprojection methods known in the CT art that accept the acquired attenuation data directly. Where is the motivation for such a round-about image reconstruction approach? This is a classic case of hindsight reconstruction of the claimed invention by the examiner. Claims 16-18 recite patentable subject matter which is not disclosed or suggested by the prior art.

Claim 19 and Dependent Claims 20-21 Claim 19 is patentably distinguishable over the prior art for many of the same reasons as claim 16 discussed above. Hu et al does not disclose or suggest acquiring interleaved, spiral scan, cone beam data as required by step d) in claim 19. As indicated above, Hu et al performs a single spiral scan of a cone beam. In addition, here is nothing in either Hu et al or Mistretta et al that would indicate how one would combine data

from two such interleaved scan patterns as recited in step e) of claim 19 to produce an image. Also, to combine Mistretta et al or any other MRI references with Hu et al is a clear exercise in hindsight reconstruction of the claimed invention. Claims 19-21 recite patentable subject matter and allowance of the same is requested.

Claims 2, 4, 5, 10, 11 and 16-21 are believed to be in condition for allowance and allowance of the same is requested. If the examiner has any questions regarding this technology or the issues, Applicant's attorney welcomes a telephone interview.

The Commissioner is authorized to charge any fees under 37 CFR § 1.17 that may be due on this application to Deposit Account 17-0055. The Commissioner is also authorized to treat this amendment and any future reply in this matter requiring a petition for an extension of time as incorporating a petition for extension of time for the appropriate length of time as provided by 37 CFR § 136(a)(3).

Respectfully submitted,

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